

## 4.

Home Life of the Bat Falcon, *Falco albigularis albigularis* Daudin.<sup>1</sup>

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[This is one of a series of papers resulting from the 45th, 46th and 47th Expeditions of the Department of Tropical Research of the New York Zoological Society, made during 1945, 1946 and 1948, under the direction of Dr. William Beebe, with headquarters at Rancho Grande in the National Park of Aragua, Venezuela. The expeditions were made possible through the generous cooperation of the National Government of Venezuela and of the Creole Petroleum Corporation.]

[The characteristics of the research area are in brief as follows: Rancho Grande is located in north-central Venezuela (10° 21' N. Lat., 67° 41' W. Long.), 80 kilometers west of Caracas, at an elevation of 1,100 meters in the undisturbed montane rain forest which covers this part of the Caribbean range of the Andes. The migration flyway of Portachuelo Pass, which is also the watershed between the Caribbean and Lake Valencia, is 200 meters from Rancho Grande. Adjacent ecological zones include seasonal forest, savanna, thorn woodland, cactus scrub, the fresh-water lake of Valencia and various marine littoral zones. The Rancho Grande area is generally subtropical, being uniformly cool and damp throughout the year because of the prevalence of the mountain cloud cap. The dry season extends from January into April. The average humidity during the expeditions, including parts of both wet and dry seasons, was 94.4%; the average temperature during the same period was 18° C.; the average annual rainfall over a five-year period was 174 cm. The flora is marked by an abundance of mosses, ferns and epiphytes of many kinds, as well as a few gigantic trees. For further details see Beebe and Crane, *Zoologica*, Vol. 32, No. 5, 1947. Unless otherwise stated the organisms discussed in the present paper were observed in the montane cloud forest zone, within a radius of one kilometer of Rancho Grande.]

## INTRODUCTION.

This is a record of observations, during a period of one hundred and sixty-four days, of the lives of a pair of bat falcons, from February 20 to August 1 inclusive, in 1948. Most of the watching was done through open windows from within our laboratory at Rancho Grande, the perches of the parent birds and their nest being in full view, at a distance of about one hundred meters. Methods included the naked eye, a 7 × 30 hand binoculars, and Zeiss giant binoculars of 12, 20 and 40 powers. This last was of course mounted on a tripod, and except when in use

elsewhere was constantly in place focussed on the perches or the nest of the falcons, so that instant contact could be made at any desired moment by myself or any member of my staff. With this battery of glasses it was possible to see every detail of color, pattern and plumage of both falcons and their victims, as well as such minutiae as the coiling and uncoiling of the tongue of a still living morpho butterfly held in the hawk's talons.

During two preceding years we had become proficient in sight identification of almost every bird, mammal and insect which entered into the diet of these falcons, and within arm's reach in the laboratory was a collection of skins of the birds themselves, loaned by Dr. William H. Phelps. This collection included all the species of small and medium birds which might possibly occur in the vicinity of Rancho Grande.

*Falco albigularis*, as a species, has an extensive distribution, covering 48 degrees of latitude, from central Mexico, south throughout South America, reaching as far as southern Brazil and northern Argentina at about 27 degrees South Latitude. Two subspecies have been described.

The bat falcon is fairly common throughout much of its range, and is accounted a bird of tropical lowlands, rather than of subtropical elevations. Brief accounts of nests, eggs and food have been published, the latter based chiefly on stomach contents.

The principal contribution of the present account is the data afforded by the opportunity for detailed identification of the diet of this pair of falcons throughout more than five and a half months, and the recording of the rise, development and in some cases decline of various instincts in the young birds.

## PREVIOUS RECORDS.

In accord with the reputed limiting of these falcons to areas of low elevation are my notes of their presence at sea-level, at Kartabo, British Guiana. In 1920 I found this species living in dense jungle in pairs, always perched in the tops of the highest trees. The adults were feeding chiefly on honey-creepers, both *Cyanerpes caeruleus caeruleus* and *Chlorophanes spiza spiza*. Three of each of these species were found in an equal number of stomachs. Rufous-throated birds of the year were insect eaters

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for the most part, large and medium butterflies, giant grasshoppers, together with small flying hemiptera and coleoptera, forming the larger proportion of their diet.

At Rancho Grande I have notes of only two occurrences of these birds, other than the pair under consideration. On July 6, 1945, at nine in the morning, I was seated near the gate of Rancho Grande compound, watching a pair of tanagers in a distant tree, when a sharp *ke-ke-ke-ke* drew my attention, and directed it to a bat falcon in the top of a lofty candelo tree, about one hundred meters away. This was the first record for this locality.

The bird looked straight at me as I shifted the barrels of the big binoculars, then shifted its gaze upward and I followed. High in a air, a flock of what to the naked eye might have been dragonflies, resolved into the entire company of Rancho Grande blue and white swallows, *Pygochelidon cyanoleuca cyano-leuca*. They were completely absorbed in the small hawk, but circling at a safe distance. Occasionally one or two reckless birds would swoop down and rush past in high gear, twittering loudly, but attracting not the slightest attention.

Every feather on the body of the hawk was frequently raised, shaken and settled, as the bird preened itself. Once a small plume fell out and drifted slowly downward, watched by the owner with complete concentration. Most of the time it stood quietly, the head moving quickly from side to side, bobbing up and down in falcon fashion. During the ensuing hour it called three times, a continued rattling, a shrill, high *ke-ke-ke-ke*, five to twelve times, very fast. Once I heard a variation *whew-ke-ke-ke*. Twenty minutes after first discovery the bird rose, called loudly, circled the tree once and started due north. Every swallow vanished, but in less than a minute the hawk returned to a perch a few feet way and equally high. As it flew over every bird sound ceased in the surrounding jungle. A tree crashed near by and there came a loud hum from a plane over Valencia, but the hawk paid no attention. When a fly alighted near its toes, it was watched closely until it took to flight.

At ten o'clock the hawk left again, this foray, after the conventional wasp-like circle, heading it eastward over the Rancho building. This time it was attended by a streaming comet-tail of worried swallows at judicious distances, all twittering as the hawk flew over their nesting crevices. Again the hawk returned but hardly had it resumed its perch when six more bat falcons circled over, high up, and with loud chattering my bird joined them, fell into their circling pattern, and all disappeared northward, directly through Portachuelo Pass. They were apparently migrants only from lowland to lowland through the flyway.

About a month later, on August 4, a single falcon drifted slowly up Limon valley toward the Pass, but soon disappeared into the thin neblina.

The following is a selection of day by day notes from my journal, excluding all unimportant matter which would gain nothing by repetition, and omitting a number of eventless captures of duplicate species prey.

In the first section, mention of individual prey is by species only, this being in accordance with sight identification. In the final systematic list, the subspecies are added, it being understood that these are based on geographical expectancies.

#### Chronology.

Adult falcons first seen, and mating	February 20
Nest discovered	March 30
Eggs estimated laid	March 1 to 5
Incubation estimated	March 5 to April 5
Hatching estimated	April 5
Week-old chicks first seen	April 11
Last visible down gone	May 5
Young male left nest	May 10
Young female left nest	May 13

#### BAT FALCON DIARY.

February 20, 1948: Heard a hawk calling at 7:30 A.M. and later saw a bat falcon with something in its claws alight in candelo tree No. 3. The large glasses showed the prey to be a male eastern swallow-tanager, *Tersina viridis*. The blue plumage filled the air as the hawk plucked out beakfuls of feathers, when suddenly there entered my binocular field a larger bird. With an upward swoop the new arrival snatched the prey, and flew off to the top-most twig of candelo No. 2. She—for that proved ultimately to be her sex—tore away at the swallow-tanager while the male watched, and picked at the shreds left in his claws.

Half an hour later the male flew straight across to the other tree, mated with the female intermittently for fifteen seconds, and then back to his own perch. Both birds left a few minutes before nine.

(Note: Directly south of Rancho Grande laboratory, about one hundred meters distant, were three very tall candelo trees, *Gyranthera caribensis*. No. 1, close to the road, fell in the rainy season of 1947. Of the remaining pair, No. 2 was to become the favorite perch of the female falcon, while No. 3, a few meters to the west, was the male's perch more than thirty meters above the ground, all in full view through the open windows of the laboratory. Both trees were on the northern rim of the steep Limon valley, facing and to the south of Rancho Grande. This valley led downward toward Maracay and Lake Valencia, and in the other direction ended at Portachuelo Pass.)

February 22 and on succeeding four days: Male arrived in early morning and left immediately.

February 27: Both birds on their respective perches at 6 o'clock, the male with a male American redstart, *Setophaga ruticilla*, which he plucked and ate. At 8 the male went to the perch of the female and chattered frequently.

February 29: Birds at 6:30. Later the male brought a female euphonia, either *Tanagra xanthogaster* or *lanirostris*. When plucked and partly devoured it was taken by the female and carried away.

March 1: Both birds at 6:30. Male made two flights far down Limon valley and finally returned with a white-breasted martin, *Progne chalybea*, a bird abundant about Maracay and Turiamo but unknown at Rancho Grande except as a migrant through the pass in late July. The female took the bird at once. Its long wings interfered with her landing and she had to circle and make a second upward swoop to her perch.

March 2 to 13: During our absence the birds were reported almost daily, the male carrying prey, but no definite identifications were made.

March 14: Both birds on their perches at 8:30. They were soaking wet after the night's heavy rain, indicating an exposed sleeping perch. Long and thorough preening, and sun bathing with fluffed-out plumage. The male made a fifteen-minute trip and at 10 o'clock returned with a small bird. As he revolved once or twice on his perch I made out glimpses of the pattern and finally identified a male blackpoll warbler, *Dendroica striata*. The air was filled with feathers as he pulled and tossed them out of his beak. Remiges and rectrices were with difficulty jerked out, but the warbler was completely plucked before the falcon began to feed. From the beginning of the defeathering at 10:05, twenty minutes elapsed before the end of the meal. There remained a head and wingless half-devoured skeleton body with a single leg. He clutched this cadaver in one lowered and extended foot, and at 10:30 yawned widely twice, and shut both eyes for five minutes. At 10:40 he ate some more and dropped what was left of skull and skeleton. I am impressed with his lack of plucking and tearing power compared with that of his larger mate.

He sat quietly until 12:15, made three short flights, capturing a honey-creeper, *Chlorophanes spiza*, and then sat in the heavy rain until his plumage was again soaked. Left at 1 P.M. and the female followed a few minutes later. She had spent the entire morning sitting motionless on her perch.

At 3 o'clock both birds reappeared, the male with a freshly caught female redstart, which the female falcon took from him, plucked and devoured. Even in the midst of violent plucking, both birds, at times, would suddenly stop and watch the path of a slowly falling feather until it was out of sight in the foliage far below.

March 15: Male perched at 6:25 with a male thick-billed euphonia, *Tanagra lanirostris*, in his claws. In ten minutes the bird was cleanly plucked and then eaten. A bit of blood and a feather fastened on the upper curve of the beak and would not be shaken off. Although the stub on which he perched was only about an inch across, and a rather

strong wind was blowing, yet the falcon gripped his prey in one foot, lifted the other and slowly and deliberately scratched and cleaned his mandible.

The female made a belated appearance and a futile attempt to snatch the remains of a bird from her mate. She then perched and kept up a violent *ke-ke-ke* at her mate, at the top of her voice, revolving the while and picking at the wooden splinters of her perch. She left soon afterward but returned just in time to snatch a honey-creeper, *Coereba flaveola*, from her mate.

The sunlight was unusually brilliant and through the forty powers lenses the bird might have been perching on my wrist. Partly exposed blood sheaths were distinct and, as I watched, a flat feather-fly slid sideways from beneath the plumage and vanished below the scapulars. When watching the bird uttering its call, I became aware that the first beak and throat effort began definitely before my ear caught the first *ke*, while no visible effort accompanied the final *ke*. I then timed three *kes* with a stop watch and found their duration summed up as exactly a second. This verified a long forgotten fact that sound travels about three hundred and thirty meters a second. So my estimate of the hundred meters from eye to bird seemed reasonably accurate. When the hawks were very excited or hungry, the acceleration of *ke-ke-kes* put all this estimate of trisyllabic tempo to naught.

March 16: Male around at 6:45 with another male thick-billed euphonia. The female falcon circled for a few minutes, then dived out of sight. After plucking the tanager the male also vanished among the foliage. When one or both birds appear there is a very evident subsidence of sound in the neighborhood and no small birds are visible, but this local alarm soon passes. Birds from blue tanagers up in size, caciques, toucans, parakeets, pay no attention. At 3:30 the male brought a short-tailed swift, *Chaetura brachyura*.

March 21: After our four days of absence I saw the male falcon this morning on his perch at 6:38 with prey. This was plucked beyond specific recognition, except that the short, thick beak and a few green feathers indicated another female euphonia. A high wind, thirty miles per hour through the Pass, made perching on one foot most difficult. As I watched, the bird was blown bodily backward; he swung out over the valley and dived out of sight still carrying the bare carcass.

March 22: Male at 6 A.M. Away until 9:30 when he reappeared with small bird prey but dived into the foliage too swiftly for further identification. On perch ten minutes later, for an hour. He makes a perfect weather vane, and today, with variable winds, faced in turn, north, north by east and east.

March 23: Male at 5:35 A.M. Returned at 6:15 with blue tanager, *Thraupis virens*, thereby betraying the apparent fearlessness

of this species in the hawk's presence. Long periods of watching the horizon and unusual plucking used up an hour in preparation, and it was not until 7:10 that the tanager was denuded of feathers. It was then carried down and away.

Two pairs of blue tanagers have their nests in crevices of Rancho Grande's outer walls, together with the blue and white swallows. This afternoon one tanager was missing from the pair in the eastern wing so I presume it was the victim. This is the first time I have evidence of prey captured in the vicinity of the laboratory. Within a week a new tanager mate joined the single bird.

March 24: Male at 6:05. Two trips without prey. The female came at 7:10, preened for a time and both left, flying northeast over the laboratory. This is the first appearance of the female in a week.

March 25: Male on duty at 6 A.M. Left and returned shortly with a dark bundle of prey which the female took at once. Instead of perching and making a complete meal, she soon dived and swooped up among the mid-foliage of the male's candelero. The big glasses showed her in the dense shade, hopping along a large horizontal branch covered with moss and small orchids, and holding a good-sized brown bat in her beak. The skinny fingers of one wing were moving slightly, and she put her burden down, bit it several times, then wiped her beak. Next she picked it up, carried it a short distance farther along a sloping limb and pushed it down hard, nudging with her beak again and again, between two leaves of a radiating monstera. The rounded head and face and the upright ears of the commonest bat of Rancho Grande were plainly visible, *Lonchoglossa caudifera*, the culvert bat. She flew away, but at 3:10 in the afternoon returned, salvaged her bat, tore at it a few minutes and carried it away.

March 26: The male arrived at 5:30 and at 6:15 returned with a still living male black-headed seedeater, *Sporophila nigricollis*, plucked it, dived and returned with empty talons. Before ten o'clock, in the course of a short flight he caught a female of the same species of seedeater which he ate leisurely. After the meal he faced the sun and I again used the 40-power lenses. I was struck with the separate muscular control of adjacent but pigmentally separated plumage areas. The rufous mid- and lower belly and flanks were often flat and tightly compressed, while the cross-banded breast, upper and lower sides were fluffed out, distinctly raised above the level of the rufous, blowing about in the breeze, wholly unlike the firmly-held rufous.

The male remained on his perch all morning and at 2:05 P.M. turned his back to the sun, spread wings and tail to widest extent, fluffed out his plumage and for fifteen minutes seemed half asleep and making the most of the rare undiluted sunshine. He then preened thoroughly and left.

March 27: Male arrived at 5:30. Quiet until 6:10 when he left his perch and flew

around the near side of the candelero; then made three complete circles, gaining height rapidly until he was only a speck, and vanished. In less than three minutes he was back on the perch with a bird. I rushed to the glasses just in time to see the female appear from somewhere, fly swiftly to him, turn on her side, grasp the bird and tear it from his claws while going at full speed. Through the glasses I saw the wings of the prey stretch wide, and put them down as a swift's. I followed her to her own perch. She began tearing the bird to pieces and I soon identified the blue and white as one of our Rancho Grande swallows, *Pygochelidon cyanoleuca*. The feathers began to fly and she ate for some time and then shifted to a perch a few feet higher on the same dead limb. At 6:30 she dropped like a plummet straight down and disappeared in the lower foliage of her mate's gigantic candelero. Search as I might, I could not locate her.

At 7:30 the male returned with an unidentifiable bird, mostly plucked before he brought it to his perch. The female later took it and carried it away. As she passed, a smoky flycatcher which I was watching vanished at full speed into the nearest leaves. The male soon flew southeast toward the first Limon ridge, between Rancho Grande and Lake Valencia. Suddenly it dropped faster than I thought any bird could ever fall.

At 8:05 the female appeared and chattered excitedly.

At 9:00 the male reappeared with what seemed to my eyes a parula warbler. When I checked up on range, I realized that the victim of the hawk was the closely related pitiayumi warbler, *Compsothlypis pitiayumi*. This is the Venezuelan representative of our northern parula, and is an inhabitant of lower, more tropical levels than Rancho Grande. The hawk plucked the small bird and ate bones and all, even swallowing several rectrices. The female watched from her perch a meter above him. After he finished his meal she flew and he took her place. When they are near to one another the difference of nine and twelve inches in size is very evident. Her creamy white collar is paler than his.

At 12:30 the male returned with a dead rufous-winged flycatcher, *Myiozetetes cayanensis*. The female started toward him but he would not relinquish his prey, flew heavily out of sight with it, returning at 3 P.M.

March 28: Male at 6 A.M. At 7 he leapt a foot up and let himself fall straight down. Far down, below the tops of the lesser trees, he passed through a shrieking flock of aratinga parrakeets, then swept up on the opposite side and back to the female's perch. The parrakeets might have been stationary in mid-air as far as speed was concerned. They were too big and too well-armed for even him to tackle. An hour later he appeared with a second rufous-winged flycatcher.

March 29: At 10:05 the male came to his perch and the moment I reached the glasses I saw he had an unusual bird. A white rump

was distinct and I knew it for a swallow, and rough-winged came to mind. Then, little by little, I saw every detail. The falcon plucked slowly and turned the prey all the way around. The tail was emarginate, the rump white, the primaries brownish, and as he began on the secondaries I saw that they and their coverts were edged with white. The head was gone but the body plumage was partly white and partly shining green, unquestionably a white-winged swallow, *Iridoprocne albigaster*. This is a lowland bird, new to Rancho Grande but recorded by Wetmore from El Sombrero. Later in the year we were to see several hundred migrating through the Pass.

The treatment of this prey by the hawk was most interesting and I watched the whole process. For twenty minutes he plucked, in a high wind, working with terrific energy on wing feathers, now and then resting by plucking a few beakfuls of body plumage. The wing got tougher as the larger primaries were reached. The thumb plumes refused to be uprooted as did one or two of the secondaries. The entire wing was torn loose at last and swallowed, remaining feathers and all, with great difficulty. The feathers stuck out of the beak for a time, until by strong effort they went down. The rectrices came out easily, and finally there remained the body, clean and intact. He had nibbled at the top of the breast but practically nothing was eaten but the entire wings. The small legs were torn off and dropped.

At 10:30 the female appeared, circling high up, and chattering. The male watched but did not answer. The prey was held in the left foot which rested on the heel. At 10:34 the female dropped, swerved inward, seized the body and left with a single motion without touching the perch or her mate. She went direct to her perch on the nearer candelo, and with ferocity ate the entire body, bones and all. The intestines came first and then she tore the body structure apart and little by little swallowed it.

After a meal both sexes occasionally indulge in a curious continuation of the feeding motions. They tug at projecting splinters of the stub and even at adjacent leaves. At last the beak is wiped and the bird settles down. Her plumage on this occasion needed much arrangement as if she had been brooding.

There was not the slightest doubt that the male prepared the prey for her. I suspected that he might take it away to the nest, until she appeared and took it. I have often seen him pluck and eat a bird wholly without the nicety and neatness of plucking and leaving the body intact when it seems intended for his mate.

March 30: At 5:45 the male perched with a small tanager, *Chlorospingus ophthalmicus*, swooped down into the foliage of his tree, and at 6:15 returned with the bird plucked and dewinged as before, but the legs intact. He watched and waited for forty-five minutes holding it out in his left foot, with

heel on perch. He would gaze down into the tree below him for minutes at a time. At 7 the female came, swooped up, took the bird and ate it. He wiped his beak again and again, and picked each toe clean. The first few times I watched this performance the male appeared reluctant to give up his prey. Now he prepares it and literally holds it out as far as possible from him. It appears as if the instinct of share your catch was incompletely developed at first, but now has achieved a definite routine. Every time the female takes food from her mate she returns to her own perch, calls, and before she begins to tear or feed, she evacuates.

From 8:30 until noon I was at Portachuelo Pass watching a heavy insect migration, and in my absence Jocelyn Crane took over, watching the hawks from the laboratory. She was fortunate enough to discover the nest of the falcons, which for the past month has been in full view from the laboratory windows.

Her notes are as follows;

9:50 A.M. Was photographing the male falcon on his perch with a telephoto lens when he vanished. Five minutes later he returned with a freshly caught bat, looking like the same species which he killed five days ago. He plucked casually at the fur but ate nothing. Saw two flat bat-flies sail away from the fur or wings, both together. At 10 the female zoomed by, making a perfect pickup. She banked back to her tree, to her regular perch while the male disappeared. She ripped off the skin and wings, eating both, one after the other.

At 10:14 she plummeted, then curved over to the trunk of the right candelo, the perching tree of the male. She vanished by the time I had refocussed the giant glasses in the general area, and then I suddenly found her in her nest. She still had the bat and was scuffling around in the shallow, apparently empty hollow, appearing and disappearing, occasionally mumbling the bat. Finally she squatted, both she and the bat sinking almost out of sight.

2:15 P.M. (Beebe takes over). Hawk calling. The head of the female was visible in the nest, no attention being paid to the loud *ke-ke-ke-ke* of her mate. The latter was on his perch with a second bat, decidedly larger and the general orange color made it undoubtedly *Chilonycteris rubiginosa*. He skinned the bat, tore off one wing and swallowed it. Called again and then dived. I followed with the glasses in time to see him reach the nest, swooping up from beneath, and deliver the bat, the female reaching out her beak to take it from him. He perched on the rim for a split second, took off and rested quietly on his perch for an hour.

#### THE NEST.

Candelo number 3, one hundred meters from our laboratory, was 30 to 35 meters high, and the nest, only now discovered, was about half way up, a large but shallow cavity in the trunk. Many years ago, perhaps in the

course of a great storm, one of the largest branches was wrenched away and fell to earth. This left a gaping wound, which sap and wood set to work to heal. Out-flaring, wavering lips of bark began to curl over the rim, then rot or water or some agent interfered and the still exposed heart wood softened and flaked away. This in no way interfered with continued growth of the enormous bole, but left a semi-hollow, shallow but well cupped, which in the year 1948 was destined to provide a home for our pair of bat falcons.

The setting of the arboreal eyrie was very striking. Three sides of the two-by-one-foot opening were exposed, lichen-covered. Down the fourth side a mass of air-plants cascaded from an enormous burst of foliage, twenty feet above. Within a few feet of the hawks' home were many kinds of lush growths which at the first hint of rains put forth new shoots, leaves and blossoms; orchids flowered, as did bromeliads, jungle arums and tropical mistletoe. Four long, dangling air-roots hung at one side with their beginnings so high up that they pendulumed slowly in the slightest breeze, and when high winds and neblina swirled through the Pass and around the candelos, the vegetable ratlines flapped and thrashed like wrecked rigging.

March 31: At 5:30 the male brought a male black-headed seedeater, and after plucking, gave it to female at nest.

April 1: Male with prey at 10:30. Mr. Fleming reports that this was a large sphinx moth, *Pholus obliquus*. The hawk ate the insect, discarding the wings.

April 2: Male flew with bat to nest without plucking or dewinging it. Later came with a gnatcatcher, *Polioptila plumbea*, which must have come all the way from Maracay.

April 4: Male on perch at 6 with bat. Without dismembering it, he called and the female came and took it to the nest. She fussed about with it for a few minutes, on the rim and inside the nest, then took flight, circled once and alighted on a branch half-way between the nest and the perch of the male. Here she laid it down, shifted it, and finally pushed her way into the leaves of a large bromeliad, and backed out without the bat. Flew back to the nest. This is the second instance of caching unwanted food, bats in both cases.

(Note: from April 5 to 9 no notes were made owing to our absence on a trip to the llanos.)

April 10: Hawk heard at 7 A.M. Fog so dense all day that no trace of candelos, hawks or the nest was visible.

April 11: Hawk on perch at 6:30 with a remarkable yellow grosbeak in his talons. It is *Pheucticus chrysopeplus*, and with its huge beak and heavy body, the streaked back and the white-banded dark wings it gives an appearance of size and weight above that of its captor. I would have given much to see the attack. My only record at Rancho Grande is of a pair feeding in a high tree.

The female hawk was on the nest, squat-

ting low. At 7:15 I heard a chattering and saw the female feeding three young birds. They were good-sized, about a week old and clad in creamy white down. At this distance they had the general appearance and size of recently hatched domestic chicks. They were fed with small bits of meat which the parent tore from the body of the grosbeak. One got less than the others. After five minutes, she stood on the rim chattering, then flew to her perch and evacuated. The babies pushed each other about. One fought to get on top, finally succeeded, turned tail toward the open rim and shot a shower of white lime drops far out, on and over the edge.

The female is now marked by slight lime stains on her longest primaries and outer edges of retrices, so even aside from her superior size and regular perch she is further distinguishable from her mate.

The deep shade and the distance of the nest from our windows had kept the secret well hidden from us. To the naked eye the nest and the bird on the rim were barely distinguishable when we knew exactly where to look.

April 12: At 10:15 the male bat falcon swung up to his perch in the top of the candelero tree with a swift. Through the 20-power glasses I could see every detail and in every respect of the cephalic pale color it seemed to be the rarest of all Rancho Grande swifts, *Cypseloides cryptus*. There was no trace of the supraloral white spots of *cherriei*, and the area around the base of the beak showed the pale grizzled appearance so apparent in both of the specimens taken in 1946. If the bird had been in my hand I could not have had a better view of every detail. It was slowly and thoroughly plucked and as the female did not appear, the male proceeded to eat the eighth known individual of this swift.

At 12:15 the male was on his perch again and the female was feeding chicks. Subsequent onrush of fog hid everything.

April 13: At 9:50 male arrived with a chestnut and gold tanager, *Tangara arthus*, plucked and dewinged it and called. Female came at once, carried it to her perch, quickly ate head and fore body and carried the rest to the nest. Could see only two young birds. Their eyes seem to have more pigment around them. The parent left after feeding, and yelling at the top of her voice, flew to perch.

April 14: While still dusk, at 5:30 I saw a large swallow-like bird dash past my bedroom window and leaned out in time to see the male falcon swoop back close beneath me and snatch a small bat from the air. The bat seemed to be standing still, so swift was the hawk. The legs went out and the mammal was seized with almost no slowing up in the space of a couple of wing beats. The hawk flapped in a half circle and then effortlessly glided with sheer impetus up to his perch. The fog prevented seeing any details of plucking but something of the kind went on, then the watching female swooped from her

perch, snatched in her turn, and took the prey to her young. A half hour later when I entered the laboratory she was just reaching the nest with a second bat, this one twice as large. She pulled it apart and ate it herself. When finished, she came to the nest rim, and for five minutes never ceased calling. The strong adverse wind kept the sound inaudible until I cupped my hands and concentrated. More angles are now visible on the chicks and the down is less dense. Before leaving she cleaned feet and toes thoroughly, one by one.

April 15: A bat caught early, the female taking it as it was, from the male at 6 o'clock.

At 7:50 male caught a hummingbird. Female snatched it at once, pinched the back of its neck, swung it in her beak for a while, then to nest and fed the chicks. She was through and calling for more all within three minutes. The bird was iridescent purplish-blue on head and breast, green elsewhere, tail bronze and the beak medium long and curved, a male blue-headed hummingbird, *Chrysuronia oenone*.

At 10:05 the male brought a blue-black grassquit, a male, *Volatina jacarina*. He must have gone far down the Limon valley before finding this lowland species. It was fed to the young. The nestlings now crane their necks up when the parents call.

A second blue-headed hummingbird arrived with the male at 1:05, and this time the female took and ate it all, feathers and bones.

April 16: Male came at 7:10 A.M. and brought a *Tangara arthus* and before he had a chance to pluck, the female had it on a branch above the nest, plucked it and tore off the long primaries with no trouble. She always appears much stronger than the male. She fed it to the young, half plucked. The third, very small, chick only got a bit now and then, and was trampled on again and again by the other two. I thought at first he was a male and the others females, but it is apparent that he is the weakling of the brood.

At 9:30 the male brought another culvert bat, and the female took it straight to the nest, tore it apart and fed fur and all. It was heart-breaking to see how the two stronger stood and pushed and gaped at the expense of the smallest. His beak would come up and as a bit of flesh was offered in the parent's beak the larger ones would snatch it and fairly trample on their weaker brother. He has not lost his egg-tooth, and is hardly half the size of the others. The moment she finishes feeding, she steps on the edge of the nest, calls at the top of her syrinx, cleans her toes and claws and flies to her lofty perch. All small birds in sight leave at headlong speed but soon return. Their fear seems deep-seated but evanescent. Also the male seems hardly ever to hunt within sight of perch or nest.

At 10:30 male caught a red-headed green tanager, *Tangara gyrola*, and it was fed,

body feathers and meat, to the young. Her instinct ends with pulling off bits of meat and pushing them into the first available beak. By sheer accident, now and then, when the larger chicks are half choking on a beakful of feathers, the little one gets a piece. At noon another bat appeared, with a repeat performance as of 9:30 this morning. After the rain the rim of the nest is quite free from lime, and the trajectory of the birds is now much higher and stronger, the fine but visible spray of white drops arching high over the nest rim.

At 1:20 another blue-headed hummingbird was caught, and required no dressing or plucking before feeding.

April 17: At 5:20 heard the *ke-ke-ke* and reached the window just in time to see the male dive at a bat close to the laboratory. The bat swung inward with such force that it struck the glass but not enough to stun it. The hawk went on with no stopping or slackening of speed, up to his perch.

At 8:25 he returned with a half-dead giant white-collared swift, *Streptoprocne zonaris*, almost as large as himself. The female took it to her perch, and there furiously plucked wing and tail feathers and about half the plumage. There is no doubt about identification, the long wings, almost as long as the hawk's, the black plumage with the white collar and maximum size of the more common species. The female hawk tore off and ate the wings. This species appeared twice more in the diet of the falcons. In the nest the littlest hawk was not visible.

At 9:50 a partly living white-winged swallow was captured and brought back. The female took it at a higher speed than I have seen before, tearing past, reaching out with all eight claws, and snatching it without effort from the out-stretched foot of the male. Chick number one was still too full of giant swift to open his beak, but number two was ravenous. The female daintily tore off a clean bit of meat, turned her head sideways and pushed it into the open beak. If by chance he got it wedged crosswise she nudged the side of his beak, loosened the bit of food and rammed it down. Finally she ate the remainder, feathers and all, and then hovered the brood. No sign of Dopey. I fear he has succumbed to the cruelty of an unvarying instinct; bringing about the extinction of the unfit.

It is significant the number of migrants the hawk is taking, as if their direct flight southward through the Pass and perhaps the slowing up against the usual updraft of wind gave him an extra shade of opportunity.

At 11:50 male came with bird, female took it, flew to her favorite horizontal, secondary perch above the nest, plucked and ate most of the wings and some bony parts. Then to nest where Number One got four-fifths of the food, only at the end when he was stuffed allowing his larger, Number Two, nest mate to get a small share. No signs of the weakling, Number Three. The prey was a black-faced oriole, *Icterus chrysater*, not new to

Rancho Grande, but very common at lower levels.

At 12:40 the male caught a stripe-headed warbler, *Basileuterus tristriatus*. The male plucked and ate wings, and gave it to the female, beak from beak. The two chicks fed greedily although their crops were bulging.

April 18: 11:15. The first prey was caught in dense neblina. The female took it to some hidden perch before we could identify it. No signs of Number Three. The smaller of the remaining two gets the major share. The parent never lets any food stick on the chick's beak, but takes time and care to remove it. When she stands on the rim she systematically cleans her legs and feet, but they still remain blood-stained. The grip which these birds have in their toes when perching is remarkable. Often in a high wind, they will draw up one leg and keep perfect balance and poise, looking around nonchalantly, with only four toes for support.

A dog-faced bat brought at 2:30 and fed to young. Later a blue tanager came close to the nest, climbing up the lianas and searching the tangle of leaves, then coming within two feet of the young hawks, and leaving without haste just before the female arrived. This shows a lack of localization of the source of danger, as the tanager was nesting in a hole of Rancho Grande, a hundred meters away.

April 19: A bat brought at 5:30. An excellent series of views showed it to be the same species as we took in Rancho Grande the night before. It was a white-lined bat, small, with a number of white lines extending over the fur, around the head and down the mid-back, *Uroderma bilobatum*. We could plainly see the yellowish base of the ear, a character which I had written on the label of the one we took and skinned.

At 2:15 the female was on the nest, facing out, close to the rim with a chick on each side, when a twelve-inch anolis lizard, the green and black banded *Anolis squamulosus*, climbed up the trunk. It made a sudden rush, up and over the rim, and the hawk with a quick movement reached forward and seized it by the head. A single pinch and it was drawn in, torn apart and fed. The chick which got the tail had a difficult time, for that organ had become detached, and began a frantic twisting and turning on its own, wrapping about the face and head of the small falcon. Finally the parent had to help poke and untwist, before it vanished, still wriggling.

April 22: (On our return from Caracas). Female took a culvert bat from her mate at 6:10 and fed it to the young. These have grown appreciatively. Although still entirely covered with grayish-white down, the wing feathers project about an inch. The size difference is pronounced, probably sexual, the smaller seeming stronger or more active than the other. The faces are light leaden blue. They are alert, watching every bird or other creature which comes within view, now and then lifting flabby, heavy

wings and flapping them as much as possible in the confines of the nest. They have, from the first, showed the vertical head bobbing of the species, as they change the direction of concentration. The whole morning was solid fog, and both adult birds sat close together on the female's tree. Later a pair of blue tanagers perched and searched for insects almost at the entrance of the nest, with both chicks looking at them. A hawk in flight would send these tanagers tearing for cover; a perching one would hold their attention and suspicion, but they seem to see nothing wrong about chicks and nest. The young now call like the parents but weaker, and have lost their baby cheeping.

3:12 P.M. Male caught a blue and white swallow, dewinged and beheaded it, eating these parts, and called intermittently for ten minutes. At 3:30 the female, who had been on a perch below him, taking no notice, finally came ambling on foot along the branch separating them and took the prey from his beak with hers. Flew off, circled and returned to her regular perch. For ten minutes she kept her foot on it, yelling now and then. At last she cached it in a bromeliad above the nest and returned to her perch.

Throughout this time the young were gorged, sunk far down in the nest, their nictitating membranes pulled far over.

April 23: At 5:45 the male was on the female's perch with a small bat which she soon took and fed. At 6:30 he had a female seedeater. At 7:30 the male brought and female took a golden siskin, *Sicalis flaveola*. In the skinning process all the loveliness of the greenish-yellow, orange and bright clear yellow came into view. This is a lowland bird. She fed it after removing only the large wing and tail feathers. A *Tanagra musica*, a black-throated euphonia, followed within a half hour. I was uncertain about the black throat and wished I could see it, whereupon the hawk held the entire bird up in her raised foot, and, with me, gazed steadily at the throat and lower parts! Again and again we should never have been quite sure of species or sex were it not for the deliberateness of the preliminary examination, and the fact that the wing feathers were the first to be removed, leaving in full view all the other portions of the plumage. At 8:55 a turkey vulture swooped low over the road and nest and the female flapped high, dived full speed and struck with talons, spang on the great bird's back. The vulture left hurriedly. At 2:15 a bat was brought and fed, and soon afterwards a black-headed seedeater was caught. These birds are lowland species but are fairly common on upland intrusions, living and nesting in the small patches of grassy open clearing along the winding road.

April 24: Several series of outeries proved false alarms, male and female sitting quietly, while yelling with all their might. We missed the early feeding. Mr. Fleming was walking along the road several kilometers down hill when a head-and-wingless swift fell at his feet, the hawk passing on out of sight. This



circumstantial evidence makes it possible to add another species to the list of prey, a chestnut-collared swift, *Chaetura rutila*. Two more individuals were later included in the diet.

April 25: Bat brought at 6:30. At 7:10 the male came yelling with prey. Female dived, swooped in a large circle and took the bird. Sat quietly, now and then holding up the bird and looking at it. All this fuss concerned only a small, female, curved-bill green hummingbird, *Chalybura buffonii*. The length and curve of the beak, the general size, the light gray under parts, were as distinct as if in the hand instead of one hundred meters away. The female plucked head and wings and then took the trouble to swoop to the nest and offer a chick the half beakful which remained.

Both parents perched for some time. Then the male aroused and went through his regular routine. He shook his head, did a single circle pattering dance on his stub, and concentrated. He bobbed in all directions but chiefly in the direction of the valley to the south. Three times he bobbed, each time four or five ducks of the whole head. He then shot off, flapped rapidly, evidently lost sight of what had attracted his attention, and returned. When he returned empty-taloned he never called. At 8:10 both birds left in a hurry and overtook a big black eagle, *Urubitinga urubitinga*, both in turn striking it feet first. The great black bird ducked and dodged, but three times the falcons rose and fell upon it, until it dived for the shelter of the trees in the valley jungle. Later, the male caught a magnificent black, gold and turquoise mountain tanager, *Compsocoma flavinucha*, and ate it himself.

April 26: A bat and a black-spotted green tanager, *Tangara chrysophrys*, comprised the morning's larder. Both birds left at 11:15.

April 27: At 5:45 the female had a large frog in her claws which the male had just brought. Glimpses made it certain that it was a zipper-backed frog, *Gastrotheca ovifera*. She carried it to the nest but the chicks did not feed while I was watching. I was sorry for this lack of verification of whether this amphibian was edible or not. An hour later she brought a plucked and evidently stiff corpse of a small bird. It had no appearance of recent killing and I can only surmise that it was a cached prey which she had hidden some time before, if not the afternoon of the preceding day.

April 28: At 6:15 the male brought a chestnut-collared swift which the female took, plucked, ate most of the head and then fed to the nestlings. At 7:15 the male returned and the female met him, calling loudly, and took a hummingbird, *Phaethornis augusti*. Plucked carefully it made only about two bites, one for each chick. After she has plucked a bird, large or small, the female may swoop down to the nest at once, or sit for many minutes, waiting until immediately after an evacuation.

The young have grown rapidly and become dull grayish-white, owing to the growing feathers. They continually preen all over, and even one another. Each has a dark cap on the center of the crown, and the legs and feet are strong and bright yellow. All of the major pterycae are now distinctly visible through the ragged down.

The bobbing, almost from the first week, is continuous. The head is turned, the glance fixed in a certain, definite direction and instantly there is a vertical bob or two of the whole head. Then the head is turned quickly toward one or the other side, and another series of jerks takes place. It is as difficult to account for as the foreleg patting or paddling of the lizard *Cnemidophorus*, or the slight withdrawing of the head and refixing of concentration on the same object as is customary in owls. All shifts of vision in the falcons take place in quick sideway turns.

April 29: A bat was brought at 6:15. Another sortie resulted in a male *Tanagra xanthogaster*. At 9:15 the female had vanished, the chicks were fast asleep, and the male was on his high perch. Eight short-tailed swifts rushed past, close to him, but neither species paid the slightest attention. A perching hawk and the same bird high in air above are two very different factors in safety or danger, in relation to possible prey.

At 11:15 the male brought a white-breasted martin, *Progne chalybea*. This is only a casual migrant, so the hawk must have brought this exceedingly heavy bird from far down the valley toward Maracay.

2:45. Note by Miss Crane: The hawk brought two hummingbirds of the same species within twenty minutes, the female taking both. They were both male racket-tails, *Ochreatus underwoodii*, breeding along the ridge at Portachuelo Pass. All four rackets were uninjured when they were brought, before plucking.

April 30: The male came at 7 and the female left. For ten minutes he continued his dance. He half raised his wings, then whittled his beak; turned a little and repeated. This continued until he had made two complete circles, sharpening and scraping on first one, then the other side of the perfectly clean mandibles, eyes closed, and rubbing with all his might. It seems to be some strange nervous preceding of hunting.

At 7:45 he left and in a short time returned with a rough-winged swallow, *Stelgidopteryx ruficollis*. It seemed a bad day for this species for a few minutes after ten he caught another.

May 1: The down on the chicks is now reduced to narrow lines of pale gray, the rufous collar and breast are distinct. First one, then the other waves the wings frantically, each in turn squatting out of reach of the other's waving pinions. There is no doubt about the pair being brother and sister, judging from relative size. At 8:30 another white-breasted martin was provided. Again and again I watch the male set a straight course down Limon valley and keep on until quite out of

sight. This must bring it into the lowland, tropical, martin territory. A bat was brought back at 10:30. The two most common species of bats which have formed a considerable portion of the food are both culvert bats, by which I mean that they roost during the day by preference singly or in clusters under the numerous culverts which guide various streams and brooks across the road. Twice I have seen the male falcon dive at these places, once passing through. At neither time did he pick a bat off the walls, but this circumstantial evidence plus the late hours in the day when bats are captured indicate that this source of manna is frequently used. In early morning I have already told of seeing the hawk take bats from mid-air in front of the laboratory. In this case the bats were snatching moths from the window glass.

May 2: Saw one of the chicks tearing up a good-sized, almost unplucked prey in the nest. There is less and less of careful preparation of the food on the part of the parents, the change nicely geared to the increasing ability of the young hawks to pluck and tear for themselves. The male clings more and more to the lateral sloping rim at one side and above the floor.

May 3: Female arrived at 5:45, called and did her food dance, revolving twice on her perch. She looked for the male, the only time she fails to bob, and he soon arrived with a vireo, *Vireo olivaceus*. At 6:28, with the female sitting quietly and the chicks with full crops, he appeared and called, this time with a male violet and yellow siskin, *Spinus psaltria*. The male ate most of it. At 10:15 she fed one chick with a racket-tailed hummingbird, a male. She left; both chicks edged toward the rim, yawned in concert and went to sleep.

May 4: At 5:45 the female arrived and went through a frantic hunger dance, revolving and tearing at the branch stub beneath her feet. Male brought a culvert bat which was fed almost without plucking. Twenty minutes later a hummingbird was brought, and the female took it and held it in her beak for five minutes. It was then shifted to the left foot. She evacuated, gazed at her prey, and with almost a single motion swallowed it whole. It was one of the smallest of Rancho Grande hummingbirds, a female short-beaked *Chaetocercus jourdani*. A skin on my laboratory table measures only 69 millimeters.

The young now exercise regularly and alternately, one climbing up the left side, giving room for wing exercise of the other. Five minutes later they will usually have changed places. They seem to find titbits on the nest floor or at least do a lot of searching. The prey is torn or plucked less and less each day. When the parent does tear the prey apart, the separated piece is snatched from her beak at once. Late in the morning the male brought a male racket-tailed hummingbird.

May 5: There is little to choose in size between each parent sex and the correspond-

ing nestling. The throat and three-fourths collar are rich rufous, justifying the old synonym *rufigularis*. The corresponding parts of the adults are creamy white. When the young wings are spread, the blood sheaths are plainly visible, but the tail seems almost full grown. Saw the smaller, the male, tentatively put his foot on the rim, lean forward and look down, then hastily draw back and scuttle behind his sister. A dog-faced bat and a blue-and-white swallow were early morning food. Again and again I notice that when the female is watching for the return of her mate, she never bobs, only turns her head sideways and up and down, scanning every bit of sky. But when looking for prey or danger or down at the nest both she and the male bob continuously, and the chicks never stop.

At 11:14 the male brought a bird, tore off the head and one leg and devoured them and the female then carried it to the nest. The bird was a female American redstart. She hesitated a moment and then left the rim of the nest, carrying the prey. At 1 P.M. she returned with the same beheaded redstart, dropped it in the nest and watched the chick on the floor and the female clinging to the side. When one of them began to tear at the bird she left.

May 6: Hummer caught at 10. Female pulled out a few feathers and left it at nest. It was a male *Anthracothonax nigricollis*. Both young birds now come occasionally to the rim and look down for a long time, then hustle back. The male flopped from his eighteen-inch upper lateral perch down to the floor, knocking over his sister in the process. Within a half hour's time the male brought a white-lined bat and a *Tanagra lanirostris*. The latter he ate himself.

May 8: Bat taken from male at 5:25 and fed. At 7:40 he brought a diminutive hummingbird, *Chlorostilbon aliciae*, tore off head and ate it, removed a few wing feathers and swallowed all the rest. The young take turns now sitting on the rim and flapping.

At 10:15 the young male was tearing at something in the nest, and lifted it. It was a male black-headed seedeater, *Sporophila nigricollis*. None of the wing feathers or rectrices had been removed.

At 4:20 Miss Crane called out that the male had prey. I reached the glasses in time to see a large, flat wing twist and fall, giving a brilliant blue heliographic flash in the sunlight. It was a fore wing of the only Rancho Grande morpho butterfly, *Morpho peleides corydon*. As I watched, the second forewing fell, and then the two hindwings dropped into the leaves of an airplant below. The male watched them spiral down, and then ate the body of the insect. This was unexpected, and another proof of the swiftness and accuracy of the hunting power of this falcon.

May 9: An almost untouched blue-and-white swallow was brought to the nest at 8:20 and the nestlings tore it apart by themselves and devoured it. At 8:30 the female called from her perch and took another bird

from her mate and ate it all. It was a female bronze-tailed hummingbird, *Agelaiocercus kingi*.

The sun was out strongly and with the 40-powers I examined the colors. There is not the least hint of white in the collars of the young falcons; the belly and flanks are cinnamon-rufous, and the breast collar is apricot buff. This color extends almost around the neck, a half inch at the nape representing the break in what would otherwise be a complete ring.

At 8:43 the female brought a mouse, probably the common jungle mouse, *Heteromys anomalus*. This she tore apart and fed with as much care as she showed in the first week of their lives. This time the young male got the first five pieces, then retired with bulging crop, and his sister filled up. The head was torn off and swallowed by the parent, whereupon she left. She simply leans forward over the rim, drops with closed wings, and in about three of her lengths the wings open and she is in the full impetus of flight. It looks so easy to me, and perhaps to the youngsters, who follow to the rim, flap, look, bob and turn back. At 2 P.M. she brought a gray-breasted swift, *Chaetura cinereiventris*, after plucking, and the nestlings did their own tearing apart. As I watched, I distinctly saw the mass of small ants when the crop and stomach were torn apart, and even several large marble-like abdomens of *Atta* queens, which were eaten by the small hawks.

May 10: This proved to be the fateful day, marking the break-up of the nesting of the bat falcons. At dawn I came down to the laboratory and started watch. At 5:30 the female came to her perch, and the male brought a short-tailed swift. It was carried to the nest and both birds fed on it.

At 6 the male caught another swift which was taken to the nest where the female picked it almost clean. Had continued perfect views of it; a white-spotted swift, *Cypseloides cherriei*. This was one of the nine birds recorded at Rancho Grande, making in all twelve known of the entire species. On his arrival the male falcon held the bird in his talons for several minutes, with the dangling head in full view. There was hardly any chin white, but very large and fluffed-out eye spots.

As happens sometimes in over-anticipated crises, the actual event came and passed almost unnoticed. I left the glasses a few moments and when I returned I saw, without emotion, the female leave the nest. When too late, I realized that it was the rufous-collared male nestling who had dropped from the rim, the remaining bird being the conservative sister. I swiveled up to the candelero perches in time to see the youngster make a crash landing—a messy five-point landing with outspread wings, tail and legs—in a clump of airplants. Slowly collecting his limbs and their feathers, he took off again, fluttered waveringly to his mother, upset her, and clung with agonizing flapping to

her perch, and finally made it. He now did three things—looked at distant Lake Valencia on the horizon, chattered *ke-ke-ke-ke*, and bobbed. Life had really begun.

[NOTE: In order to effect ease of recognition and clarity of distinction, which are the principal objects of nomenclature, from now on I shall use the following terms: adult male falcon—Male; adult female falcon—Female; young male falcon—Bob; young female falcon—Nod. Q. E. D.]

At 6:30 the female swooped back and forth around the perch to which Bob was still glued. She then dived with great speed beyond her candelero down the valley and a few seconds later came fluttering up with a bird, the first we had ever seen her catch since the beginning of the nesting. She held it for a time, then half plucked it, ate the head and went to her favorite branch, pushed it down among bromeliad leaves and returned to her perch. The bird was the warbler, *Basileuterus culicivorus*. Both adults now made swooping circles around the candeleros. At 6:40 she returned to her prey, retrieved it and carried it to the nest where Nod disposed of it.

From 7:03 we watched the remaining nestling. It was a period of great emotion, the strain of the pull out into the great world, versus the safety of the nest. The bird would balance on the outer rim, with wings half raised, teetering forward on her toes, almost go, then turn back. Then would ensue a period of violent flapping, in as wide an arc as the confines of the nest permitted.

She would climb to the top of the side wall and pretend to swoop on some prey, a bit of left-over food on the floor, and finally while the fine frenzy lasted, again step to the nest edge, duck and bob, and gradually subside into a yelling mound, crouched on the bottom. The trigger was not quite set. Meanwhile both parents and brother were out of sight high overhead, with no encouraging calls or even casual visit, or any show-hows.

At 7:40 the male swooped southeast toward Guamitis and returned in three minutes with a hummer, *Chlorostilbon aliciae*, which he ate complete, head, bill, all. Off he went and at 7:46 brought another hummer which the female took. This was *Chalybura buffonii*. At this moment the young bird, Bob, flew across the gulf to near the top of his nesting tree, not far below where the male was perched on his favorite topmost stub. The female brought the remains of the hummer to him. He had landed in a mess of smallish dead twigs and slipped and slid, trying to change the bird from beak to claws. But it was too much and the prey slipped and fell far down through the leaves, probably to the ground. He then found a small smooth area, surrounded by small bromeliads and some tiny-flowered orchids. He had a grand time climbing up and down, into the bromeliads, pecking at

lichens. A circling fly occupied all his attention and he almost twisted his head off trying to follow it. Then he preened.

Meantime the male left twice, flying far out over Limón Valley, and dropping like lightning to the tree-tops, but returned without prey. This was at 8:30, and again he went and failed to kill. At 8:55 a red-headed green tanager, *Tangara gyrola*, hopped about just behind the young hawk, arousing not much more interest than had the fly. But when the male returned, the tanager fled with every bit of wing power. The young bird now discovered a distant turkey vulture, and squatted and bobbed as if he was about to take to wing and attack the strange creature. At 9:12 the vulture approached and the female drove it headlong away.

At 10:55 the male came with a blue-and-white swallow and the female took it to Bob, on his broad, horizontal branch. He ate about half and accidentally dropped the rest. When the female came near to watch the eating, Bob turned his back and chattered. Then she went to a slightly higher branch and Bob followed, foot over foot, parrotlike. He came very close and yelled for more food. Twice she moved and he followed.

At 11:10 she swooped down, took a quick look at the nest and Nod and left, leaving a furor of flapping and pseudo-preparation for flight, with no result. Nod seems afflicted with incurable hypsophobia. Noon, no change; everybody preening.

At 12:10 Bob got up to the top perch of the male, and took up his stand no more than an inch or two away. There he remained, staring at his parent and yelling unceasingly. Parent, from my human view point, looked embarrassed and nonplussed, and gazed everywhere but at his offspring. It was amusing and at the same time very interesting that Bob, who had never seen or been fed by his father, should choose to go not to the more accessible female's perch, but laboriously clamber up to the male.

At 12:30, practically pushed off his perch, father fled, followed awkwardly but persistently by Bob, the latter circling twice with his father in mid-air and then collapsing in his mother's tree. Again Bob tried to approach his male parent, but father was fed up and refused to budge or pay attention to his clamoring issue. Bob at last flopped to his more horizontal, comfortable branch where he had eaten his first meal. At 1:50 Bob flew to his mother, knocked her off and alighted. From now on neblina prevented all observation. Late in the day I saw Bob fly into the heart of his mother's tree.

May 11: 5:15 Bob yelling like mad.

5:30 male brought bird, female plucked it thoroughly and fed to Bob who was still in the heart of the tree. The prey was a *Coereba flaveola*. Bob later flew out to a branch between those of his parents.

At 6:15 the female flew to nest, went in and looked at Nod, stayed a moment and left. Five minutes later returned with partly

plucked calliste, the black-spotted *Tangara chrysophrys*, and Nod fed on it.

At 6:30 Bob flew down near nest, then into it. He took the remains of the calliste from Nod, and covered over it in a corner, tore it apart and devoured what was left. Then he climbed up the slanting side of the nest, and before he flew, soiled Nod's plumage with a shower of lime. He had experienced only twenty-four hours of freedom, yet in this short time he had lost the mutual, or at least not unfriendly sharing of food, as well as all directive instincts of nest sanitation.

7:15 male brought hummingbird, female took it and ate it all, a small *Chlorostilbon canivetii*. The color characters showed distinctly. At 7:25 the female herself caught a Rancho Grande blue-and-white swallow, brought it to nest and both birds fed. At 7:35 male caught a *Chalybura buffonii*, took it to his perch and ate it all. It came from near a flowering tree, some distance down the road, greatly haunted by birds of this family. It may be that the abundant supply of hummers was taken as they fed from jungle trees. 7:40 both young in nest preening. Adults circled trees several times, calling loudly. At 8:05 Bob out into the thin air and alighted near the male.

8:20. Male left and flew out over Limon Valley with his swift-beating flight, a very rapid beating of wings, followed by a space of slower beats, then repeated. I followed him with No. 7's. Before long I saw him waver and dodge; then four birds of his own size swooped at him, two or three times. Once he turned sideways and I could see his out-stretched claws. He seemed to turn back and I lost him, but the four birds flew toward me and passed north directly over Rancho Grande, a quartet of white-collared giant swifts. Not very long ago he had brought one of these birds to the female. Apparently they are not afraid of him when on a level; they can probably outfly and out dodge horizontally, but when he has elevation, with the lightning-like speed of his plunge, it would seem that no flying creature can escape. He was back on his perch within the minute.

8:45. Bob returned to nest and ten minutes later left again. He returned twice more to the nest. Actions of all obscured by neblina.

4:00 P.M. Male caught, female plucked and fed a *Tangara arthus*. Both young in nest. Bob seized it and hovered over it in a corner, and after the female left, every bit that Nod got was only after a struggle and a severe tussle. All tolerance and friendly sharing were gone after a few hours of the wide world. His whole psychology was changed. Yet sufficient independence had not been acquired to prevent a return to the nest.

For an hour or two in the afternoon Bob perched on the topmost stub usually occupied by the female.

May 12: 5:15. In the dusk Bob called loudly.

5:25. In dim light, male brought a culvert bat, female ate some, then carried it down to the nest to Nod.

6:00. Bob now appeared, damp and dishevelled, having apparently spent the night in the open. He flew to the long oblique bough in female tree, and ascended it by fits and starts, half like a woodpecker, half like parrot, then flew, pushed off the female and on to the highest stub of the tree.

Male made several forays. When he returned empty-clawed he did his frantic dance of sharpening his beak, revolving several times on top of his narrow perch. Then he brought a short-tailed swift, ate half and the female took it and ate the remaining half. Bob yelled continuously. He can fly well in wide circles but makes terrible landings, especially crashing in thick foliage. He soon stopped calling, so must have had a meal while I was away from the glasses.

8:50. Second bat brought, male to female to Nod in nest.

9:02. Female caught big cicada and ate it. I had heard the loud zzzzz of a "six o'clock bee" stop suddenly in mid-roar, and it may have been this individual. Wings not eaten.

9:40. Very small hummer with a short, almost straight beak; another *Chlorostilbon canivetii*. Male to female. She plucked all long feathers, flew to Bob ten feet away and thrust it at him. He spent much time yelling and looking in all directions before he ate it.

11:06. Male caught hummingbird, gave to female who plucked it and carried it to Nod in nest. Male *Chrysuronia oenone*.

4:30 P.M. In gaps of swirling neblina saw both young in nest.

May 13: Early this morning we heard an uproar of chittering and at 6:00 through the glasses we saw the nest was empty. Nod had flown at last. Later we saw her high up near the female's regular perch. 10:05. Male brought a mockingbird, *Mimus gilvus*, to his perch, plucked off a few tail feathers and the female took it and vanished in the heart of a mass of airplants in her tree. The hunter must have gone beyond the limits of the National Park, even to Limon, to get this lowland species. Neblina shut down on further observations.

May 14: No chance of naming birds brought to youngsters. Rain and neblina opaque. At 6:10 this evening, when sky cleared for a time, saw Nod back in nest.

May 15: Took glasses to bedroom, and in morning saw female come to her perch exactly at 5:30 A.M. Nod left the nest and alighted below female five minutes later. Then the old and young males arrived. The parent made six dives in the thin neblina before he caught a *Chlorospingus ophthalmicus*. Gave it to female who gave it to Nod, who ate for a short time, then Bob took it and finished it.

The difference between the ages are the pale throat and collar of the adults and the

yellow of the old ones instead of bluish cere. Twice the young flew against the old birds and dislodged them, yelling for food. Once the young followed the old male in flight, but when the parent wished to lose the youngster, he side-slipped and turned like a streak, leaving his offspring floundering in mid-air.

On the other hand, the most interesting thing of this morning was the occasional brushing off of their perch of the young birds by the parents, a very evident intention to get them on the wing, again and again.

At 7:30 the male caught a female *Anthracothorax nigricollis*, followed by the regular routine of female plucking, eating head and giving the rest to Nod. As she was eating it I saw two birds shoot past at great speed, and the next glimpse showed the male falcon in pursuit of giant swifts. A moment later the falcon returned empty-taloned. Horizontally, there is no doubt the swift can out-fly the hawk.

At 8:10 there was a quick triple play of a tiny iridescent green hummingbird, *Chlorostilbon canivetii*, one of the emeralds, hardly more than two and a half inches overall. After its arrival, it passed in a matter of seconds from male to female to Bob, who flew off and made a crash landing among leaves but clung to his morsel. When he climbed into the open, having transferred the bird to his beak, he stood, chattered to the world and watched the horizon for three minutes before he partly plucked and devoured the little creature.

At 11:30 the female flew to her perch with a small, compact bundle which turned out to be the white-throated head of a Rancho Grande swallow. She must have plucked the bird, decapitated it, and given the rest to her young. At noon I happened to look at the nest and there was Nod with the rest of the swallow, working on it by herself.

May 16: Took glasses to room. Female flew to perch at 5:20 A.M., followed almost at once by the other three, Nod coming from nest. All flew about calling and perching now and then, then both settled on high branches and the parents vanished. At 5:35 female took a small bird from male. Bob flew up and clung partly to the female's perch. Only after a tussle would the female give up the bird, but finally Bob got it. It was *Chrysuronia oenone*. Soon the male brought a short-tailed swift, when neblina settled down and stopped observation.

At 1 P.M. the female herself caught a male *Volatinia jacarina* and after plucking and eating the head, gave it to Bob. He did not immediately eat it and his mother tried to get it back from him, whereupon he devoured it hastily.

May 19: (After two days in Caracas). Missed early catches but at 7 A.M. the female arrived with male *Sporophila nigricollis*, was attacked by Bob but shook him off in mid-air in no uncertain way and ate her bird in peace. After removing most of the feathers she ate every part, including head, wings,

legs and feet, then for some time she performed her picking dance on the stub.

At 7:30 female, Bob and Nod close together at the top of the candelo. The young are greenish-blue around the eyes and on the cere where the parents are bright yellow. They have not learned yet to face up wind, so their plumage often blows the wrong way. Also their stance is uncertain, and they still creep and crawl along a branch with help of waving wings. In flight they have good control and are strong, but alighting is still weak, and I have seen no attempt to learn to hunt.

The male brought a hummingbird at 8:20, a *Chrysuronia oenone*, and ate it. This seems to be the regular early morning routine, a bird to each young, or perhaps a bat, or a second bird, then one each eaten by the adults. There is often a second morning's period of activity, but little hunting in the middle of the day; a final season of hunting activity comes in the afternoon.

At 10 a vulture soared low over the candelo tree and the two falcons took after him at once, and alternately hit him again and again, driving him dodging into the valley. The youngsters followed behind their parents, screaming lustily. This day after day watching impresses me with the total lack of play or any alleviation of their routine. They arrive in early morning, watch for a time; dash off, kill, feed their young and themselves, perhaps repeat, and when all are fed they sit quietly for hours, forever looking about and preening, seldom sleeping. In late afternoon the activities are repeated, and sometimes before dark they vanish, going somewhere to sleep.

At 4:30 all four falcons were, for the first time, within the same field of view of the 20-powers. At 4:45 the male made two unsuccessful forays. The young got very impatient and bothered the female. Then both, on separate perches, began tearing at the surrounding leaves, making the bits of old airplant flower stalks and dead leaves fly, while Nod ripped up bits of loose bark and lichens. It was an interesting imitation of the adults.

May 20: After the first terrific rainstorm of the rainy season, at 12:30 saw Bob in nest eating the remains of a bat. He left and all four did much circling and chasing one another. At 4 o'clock all four joined in a renewed season of flight, diving at one another, and playfully striking with out-reaching talons. I was wrong in the matter of play practice. At 4:30 female caught a white-breasted martin. Yesterday I saw about forty of these birds passing down Limon Valley.

May 25: Twice the young birds have been seen to drop prey which had been given them or taken from the parents. The first time it was a blue-and-white swallow, which dropped and flew off apparently unhurt. The second time a female euphonia dropped headlong when the young lost its grip. Early morning and especially in late afternoon, just before the birds disappear for the night,

the aerial evolutions continue. Several times I have seen the female, and once the male as well, literally brush or knock the young birds off their perch, and the young then pursue their parents at full speed. The favorite circling and pursuit area is near the Pass and down over the caciques' tree, the latter seeming to pay no attention.

May 27: Male on perch at 5:15, others soon after. Nod swooped down for a brief visit to her nest, perching on the rim for five minutes. A bat at 6:10 from male to female to Bob, a small species with small, rounded ears. She had trouble with the wings. A bird at 6:55, male to female to Nod, who took it to a special perch of her own. This was a jacamar, *Galbula ruficauda*, the first of its kind. The wing and tail feathers came out easily, but she could do nothing with the head or long beak and ate only what she could detach. At 7:15 male dined alone on a *Adelomyias melanogenys*, the first of this species to enter into the falcon's diet.

May 29: Late afternoon notes: 4:45, both adults left for the night. At 5 both young flew in large circles, over Rancho Grande down south and back, occasionally closing wings and making a little swoop. Returned, perched close together, and yelled in concert. Bob vanished. Nod returned from a short flight with something in her claws, which she dropped in mid-air, a yellow butterfly, *Phoebis eubule*. It seems to have been her first catch.

Later, adults appeared unexpectedly. Sat for a while, then they went for good. Bob flew into the heart of candelo number two, and Nod flew down for a night in the nest.

May 30: This morning got the clue to the beginning of hunt learning. They were both knocked off their perches and followed and struck repeatedly at one or the other of their parents. Then Bob circled and again and again dived and struck at some small insect, never getting it. Then repeated twice, and both youngsters did it. A large yellow leaf fell from the candelo and Nod swooped after it but missed. Yesterday she had been more successful with the pierid butterfly. This seems the transition from flight learning to the first attack. It would seem that the final finished lethal swoop must be many weeks away.

May 31: All four at 5:30. Adults left almost at once, young made a few circling flights. At 6:15 male returned with prey which Bob snatched and took behind a limb. Although I could not see it I knew it was a bat, for throughout the plucking in a fair wind, not a feather drifted away. Later Nod perched below her father and yelled continuously until he left. Then she swooped and chased a swallow in front of Rancho Grande, missing it by a mile, more or less! Her first attempt on a real bird as far as my observations went.

June 5: (After return from Caracas). At 11:54 three falcons in the same candelo, the male, Nod and Bob. Nod was holding a short-tailed swift and plucking it. Bob was watch-

ing with only casual interest so he must have already fed. Two primary feathers soon dropped and drifted away in the breeze. Bob made a feint after them and finally swooped and came back with both in his beak. He toyed with them, let them drop. Soon he repeated his capture with another feather and still another. In this way was skill attained.

June 6: At 8:15 and again at 10 I was at the Pass, watching with amazement as flock after flock of sharp-tailed manakins, *Chiroxiphia lanceolata*, went past overhead, from south to north, 8 to 26 in each group. These are rather solitary residents of lowland jungle and this was an unexpected minor migration. Between these times I was behind my glasses in the laboratory and at 9:15 I saw the female falcon holding and slowly plucking one of these beautiful birds. The tousled scarlet, blue and black was then given to Nod. In this case, as in many others, the falcons drew upon the regular or irregular migration through the Pass.

June 10: At 1:30 a swallow-tailed kite appeared and the female falcon took after him, later joined by the male. They swooped with terrific speed, but the kite simply side-rolled, with effortless but lightning-like countering movements, and the falcons shot past and never hit. He rose a hundred feet and then returned, seeming to enjoy the conflict, giving a sense of reserve strength and speed which put the utmost efforts of the past masters of the air—the falcons—to naught. Never have I seen such different, and such perfection of, aerial evolutions. While the kite seemed merely to be egging on the small birds, they were in deadly earnest, wasting much energy in loud chittering. When he desired, he rose in a spiral, losing only a few feet at each counter, and vanished through the Pass.

The daily pursuit in mid-air of young and old falcons goes on steadily, morning and late afternoon for many minutes. It is definitely a method of practice.

June 11: After flight evolutions Nod was traced to a stub above the nest. She flew down and dug or scraped about on the floor for a long time. Male later brought a fork-tailed swift, *Panyptila cayennensis*.

June 12: 8:15 Bob nowhere in sight. Nod quiet on top perch. Male brought bird, female began half-heartedly to pluck, held in it beak, then called loudly. The bird is a male golden siskin, *Spinus psaltria*. Female dived with it to nest, entered, waited, called loudly, stood on rim and left. She carried the prey up to a horizontal branch and cached it among some airplant leaves.

June 13: At 6 A.M. female arrived with bird and was mobbed by both young. Bob followed her to perch and almost knocked her off and got the prey. I followed him to his own perch, where he spent much time calling and bobbing and looking around before he began plucking. I first saw the spiny tail, then the long, curved wings, then the head and knew it was another of the rare white-spotted swifts, *Cypseloides cherriei*, the ninth spec-

imen seen by us at Rancho Grande and the twelfth known to ornithology.

June 17: The young arrive before the old birds these mornings, and chitter till their parents appear. Then more calling until the birds start off hunting. Nod appeared with a long, thin object, and found she was carrying a good-sized stick, a half-inch through and four long. She circled again and again, dragging it with her, and finally tried to alight, and got it stuck with her own wing over a branch, finally having to let the wood go. But she retrieved it before it struck the earth in the best performance I have seen. Carrying it to a higher perch, she savagely bit off pieces of rotten chips.

June 19: For two days Nod has been left alone by the other three birds, spending much of the time on a top branch calling. At 10:15 she was tearing apart a white-breasted swift, *Aeronautes montivagus*. Two hours before I had seen six of these birds rushing south through the Pass, and suppose that the falcon's prey was one of these unusual migrants. Other individuals of this swift were taken on April 4 and June 19.

June 22: The morning activities are now shaping into a new and final pattern. At 5:30 A.M. Nod arrived on her perch. For 45 minutes she called and did her hunger dance. At 6:15 the female swooped up, called, looked at her offspring and streaked for Limon Valley. Until 9 Nod waited and called. Then she flew down to the nest and lighted on the rim. This seems an unusual thing for a hawk to do. Forty-one days ago she left the nest and now she returned and the rolling neblina hid her from my view. Bob appeared at noon for a few minutes. Nod alone until she left at 6:15 P.M.

June 23: Nod on perch at 6. The other three soon arrived and left. Nod did her dance, frantically picking at the lichens, patting with her feet and revolving on her stub. At 11 female returned with a hummingbird, a *Chrysuronia oenone*. Bob returned at noon, apparently well fed, for he paid no attention to his sister who, having disposed of the hummer, was now happy with a bat.

June 26: Female brought a short-tailed swift. Nod met her in mid-air, took it and promptly dropped it. The female swooped but was too late to retrieve it before it reached the jungle foliage. Came back and chattered, with what sounded to my human mind appropriate sentiments, and left. When Bob came Nod chattered to him and begged as if from a parent.

June 28: Nod at 5:30. Flew about and occasionally hesitated and shifted with outstretched claws as if reaching for some invisible prey. No parents, and soon neblina enveloped her. Just at dusk, as I was passing, I saw fresh lime on the nest rim.

June 29: Nod flying in early morning in large circles, now and then striking at something, but as far as I could see, getting nothing. On her next flight she slowed up abruptly and struck at what looked like a small bat. She seized and took it to her perch. As I

focussed, she tumbled off and perched on a lower branch. She held a full-sized male hercules beetle, *Dymastes hercules*. The elytra of the great insect seemed to have closed down over one of her toes, and she had trouble tearing it away. The elytra and the flying wings were then torn off and the body was eaten.

June 30: Nod flew up from the direction of the nest at 5:55. After I had finished breakfast I saw she had a small bat and the female falcon was just leaving for the valley.

July 3: At 11 Nod left her perch and swooped down close to where I stood in the road, and clutched something in the top foliage of a tree. She emerged with a giant, red-winged grasshopper, *Tropidacris dux*, which fluttered as he was being carried. Finally he freed himself, but Nod swooped and caught him fairly in mid-air, and ate all but the wings.

The routine now is, Nod sleeps near or in the nest, and perches early. Bob and the parents appear later than before, sometimes coming for an hour around mid-day. The female still feeds Nod but irregularly. She is usually alone in late afternoon and leaves about 6 P.M.

July 5: 9:15. Both young birds mobbed the female when she appeared, although she had no food. For most of the morning they hawked after insects. One caught a big yellow butterfly, *Phoebis eubule*, and Nod flew after but missed two others. The birds are far from skilful but are eking out their reduced rations with insects.

July 8: At 10, fairly heavy neblina and chilly. The young birds hunted insects, once swooping over Rancho Grande and sending every swallow, old and young, into the rooms. When the old falcons are not around, the swallows seem to pay little attention to the young birds, very distinctly seeming to gauge their ineffectiveness in the air. Bob appeared and with Nod made twelve attacks on a lone yellow butterfly, but it flicked aside every time. As entomologists the young hawks use up a tremendous amount of energy for very small pickings.

At 10 the female came to the tree with a chestnut-collared swift and Bob seized it. Before it was devoured, neblina closed in and the rain came down in torrents. At 12:15 the weather had cleared and Nod was soon perched with a prize. She had caught herself a giant, white-striped nymphalid butterfly, *Victorina epaphus*. A few minutes before, we had seen four and twenty of these butterflies flying south through the Pass. At her first peck the wings hung down in full view, then they fluttered away to earth, and the hawk ate every particle of the insect and picked at the stub splinters afterward. Later, when all four falcons were perched on their lofty perches, a rufous-tailed squirrel naively came and looked into the nest. He would probably have been perfectly safe; much too large and heavy even for the valiant falcons.

July 9: Male and female at 5:45 and both went through their dance. At 6 Nod caught

a sphinx moth at the first attempt, and ate it. It was a green *Xylophanes*, species not recognized. At 7:15 Bob dashed into a mass of tree-top leaves and emerged with an eighteen-inch slender greenish snake in his claws. Probably the common *Herpetodryas carinatus*. He half lost the reptile, got a fresh hold, and when the serpent twisted upward lost it for good, and it fell still writhing into Limon Valley. At 12:30 Bob and Nod sailing around together. Bob dived at a passing insect, caught it, and in mid-air transferred it from claws to beak. Saw its knobbed antennae and coiling tongue and then the wings of a papilio. Fleming looked and identified it as one of the tailless aristolochia group, *Papilio arcas arcas*, a male. He had just taken one at kilometer 31, and I had seen it at the Pass this very morning. Bob pinched off one green and black forewing, which I watched as it fluttered slowly down to the very jungle floor. Then the scarlet and black hindwings dangled and showed every detail. She nibbled at the body and then discarded it, after all her work. This very likely reflects the supposedly inedible, bitter quality of the body juices of this group of butterflies.

Both birds launched out and Nod returned with a sizeable green leaf, and did her dance, pretending to bite at the leaf as she held it in her claws. Rain started straight down and both took a real bath, spreading wings and tail to full extent and revolving on their tiny perches. It was the first real relaxation I have observed in the family.

July 11: At 9:45 Nod suddenly swooped down to the nest and spent twenty minutes there, scuffling around the bottom, pecking and gazing from the edge at nothing in particular. The increased lime marks on the rim make it certain that she must sleep there. Today is only two days less than two full months since she left.

July 12: Much rain and neblina so I missed the hunting and feeding. At 8:45 Nod dived after and caught a yellow leaf and devoted much energy to its destruction. At noon, female came with bat, was mobbed by both young. All were absolutely soaked but Nod won out and would not give up the prey.

July 14: At 10:30 we left the Pass and soon afterwards onrushing, low neblina sent the migrating butterflies high into the air and the young falcons had an exciting time. Bob dived twice at a dark butterfly which turned out to be a *Victorina*. Bob chased the butterfly and Nod chased Bob, but at last Bob found a safe perch and ate his prey. Nod went to the nest, climbed up on one side, then swooped out and caught a dark nymphalid and ate it quickly. A single glimpse of the under wings identified it as *Marpesia coresia*. Then out again and flushed a large caligo from a tree, *Caligo eurilochus*. The great owl butterfly rose swiftly and darted irregularly upward, but at her first down swoop Nod got it. She carried it to the nest and one huge wing fell to the bottom as she ate the insect.

At 12:15 Bob got a small hummingbird



which his mother brought him, and devoured every bit. It was *Chlorostilbon aliciae*.

I tried to locate Nod's *ke-ke-ke* on the scale, and it proved to be the note B, two octaves above middle C, much higher than one would think.

The long, dangling bunched masses of orchids almost overhanging the nest of the falcons have never fruited, although they have blossomed. This is doubtless due to their never having been visited by hummingbirds, for obvious reasons, and therefore have never been fertilized. The orchid is *Elleanthus* species? (Department Tropical Research, Bot. Cat. No. 140). Similar plants and flowers on the neighboring trees have all fruited.

July 18: For the first time in the history of the family, no falcon in sight all day, not even Nod.

July 19: Nod on perch early. Bob at 6:15, both soon leaving.

July 23: Bob on perch at 6, and saw Nod leave the nest to join him.

July 27: More and more the three hawks are away and Nod is alone, but occasionally fed by the female. She sleeps every night in the nest, and early this morning, after a long downpour in the night, I saw Nod on the rim and Bob behind her, both with dry plumage, so they must both have spent the night there.

July 29: At 4 P.M. a very severe electrical storm, and Nod appeared and flew to the nest where she looked out at the bad weather in perfect shelter. Either this behavior is a sign of weakness and inability to face the elements, or it may represent an advance on Bob, an ability to utilize shelter and thus husband energy. All depends on whether Bob has outgrown her in expert foraging for himself. At dark she was still crouched in the nest.

July 31: Nod on perch alone in morning. At dusk Nod in the nest.

August 1: Early this morning Nod caught and brought to her perch a hummingbird, *Chrysuroia oenone*, and ate it. As far as I know this was her first vertebrate prey caught alive.

At 10 A.M. we left Rancho Grande, so this is the last note made on the life history of *Falco albigularis*.

#### SYSTEMATIC LIST OF OBSERVED PREY AND THE NUMBERS OF INDIVIDUALS CAPTURED BY *Falco albigularis albigularis*.

Species represent certain sight identifications; subspecies are based on geographical expectancies.

#### Mammals — 33

- Heteromys anomalus* (Jungle mouse) — 1  
*Carollia perspicillatum* (Dog-faced bat) — 4  
*Chilonycteris rubiginosa* (Large orange bat) — 3  
*Lonchoglossa caudifera* (Common culvert bat) — 23  
*Uroderma bilobatum* (White-lined bat) — 2

#### Birds — 163

- Apodidae — 26  
*Streptoprocne zonaris albicincta* — 3  
*Chaetura cinereiventris lawrencei* — 1  
*Chaetura brachyura brachyura* — 12  
*Chaetura rutila brunneitorques* — 3  
*Cypseloides cryptus* — 1  
*Cypseloides cherriei* — 2  
*Aeronautes montivagus montivagus* — 3  
*Panyptila cayennensis* — 1  
  
Trochilidae — 34  
*Phaethornis augusti augusti* — 1  
*Anthracothorax nigricollis nigricollis* — 2 (males)  
*Chlorostilbon canivetii caribaeus* — 3  
*Chlorostilbon aliciae* — 3  
*Chrysuroia oenone oenone* — 9  
*Chalybura buffonii aeneicauda* — 2  
*Adelomyias melanogenys aeneosticta* — 1  
*Ochreatus underwoodii polystictus* — 7 (6 males)  
*Agelaiocercus kingi margarethae* — 5 (4 males)  
*Chaetocercus jourdani rosae* — 1  
  
Galbulidae — 1  
*Galbula ruficauda ruficauda* — 1  
  
Pipridae — 1  
*Chiroxiphia lanceolata* — 1  
  
Tyrannidae — 6  
*Fluvicola pica pica* — 3  
*Pyrocephalus rubinus saturatus* — 1  
*Myiozetetes cayennensis rufipennis* — 2  
  
Hirundinidae — 17  
*Progne chalybea chalybea* — 4  
*Stelgidopteryx ruficollis aequalis* — 2  
*Pygochelidon cyanoleuca cyanoleuca* — 7  
*Hirundo rustica erythrogaster* — 2  
*Iridoprocne albiventer* — 2  
  
Mimidae — 1  
*Mimus gilvus melanopterus* — 1  
  
Sylviidae — 2  
*Poliophtila plumbea plumbiceps* — 2  
  
Vireonidae — 1  
*Vireo olivaceus vividior* — 1  
  
Coerebidae — 5  
*Chlorophanes spiza spiza* — 1  
*Coereba flaveola luteola* — 4  
  
Parulidae — 10  
*Compsothlypis pitiayumi* — 1  
*Dendroica striata* — 1  
*Setophaga ruticilla ruticilla* — 5  
*Basileuterus tristriatus meridanus* — 1  
*Basileuterus culicivorus cabanisi* — 2  
  
Icteridae — 1  
*Icterus chrysaterus giraudii* — 1  
  
Tersinidae — 1  
*Tersina viridis occidentalis* — 1  
  
Thraupidae — 19  
*Tanagra musica intermedia* — 2  
*Tanagra xanthogaster exsul* — 1  
*Tanagra trinitatis* — 1  
*Tanagra lanirostris crassirostris* — 2 (males)

*Tanagra* females sp? — 3  
*Tangara chrysophrys chrysophrys* — 1  
*Tangara arthus arthus* — 3  
*Tangara gyrola toddi* — 2  
*Compsocoma flavinucha venezuelana* — 1  
*Thraupis virens cana* — 1  
*Chlorospingus ophthalmicus jacqueti* — 2

Fringillidae — 12  
*Phœnticus chrysopeplus laubmanni* — 1  
*Tiaris bicolor omissa* — 1  
*Sporophila nigricollis nigricollis* — 5  
 (males)  
*Volatinia jacarina splendens* — 2 (males)  
*Spinus psaltria colombianus* — 2  
*Sicalis flaveola flaveola* — 1

Unidentified birds — 26

### Reptiles — 2

*Anolis squamulosus* — 1  
*Herpetodryas carinatus* — 1

### Amphibia — 1

*Gastrotheca ovifera* — 1

### Insects — 19

#### Lepidoptera

*Marpesia coresia* — 1  
*Phoebis eubule* — 5  
*Victorina epaphus* — 2  
*Papilio arcas arcas* — 1 (male)  
*Morpho peleides corydon* — 1  
*Caligo eurilochus caesia* — 1  
 Unidentified butterflies — 3  
*Pholus obliquus* — 1  
*Xylophanes* species — 1

#### Orthoptera

*Tropidacris dux* — 1

#### Homoptera

*Cicada* species — 1

#### Coleoptera

*Dynastes hercules* — 1

### GENERAL SUMMARY.

Taking into consideration the many days away from observation, and the intermittent hours which we were able to devote to watching, a conservative estimate of individual prey captured by the bat falcons during the five and a half months would be not less than 600 birds and bats.

The total recorded is as follows:

	Species	Individuals
Mammals	5	33
Birds	56	163
Reptiles	2	2
Amphibia	1	1
Insects	14	19
	<hr/>	<hr/>
	78	218

The proportion of essentially aerial forms is as follows: bats 4 species, 32 individuals; swifts 8 and 26; hummingbirds 10 and 34; swallows 5 and 17; lepidoptera 11 species and 16 individuals. This totals 38 and 125, which thus comprise respectively 50 per cent. of all the species, and 57 per cent. of all the individuals. These figures of essential flyers do not include such aerial-feeding birds as galbula and flycatchers.

Another interesting fact is the large number of lowland forms in the diet. Some of these may have been taken as they migrated through Portachuelo Pass, but the majority must have been transported several kilometers from the relatively low country about Limon and Maracay. There is no doubt but that the majority of the prey was captured at a considerable distance from the nest.

Concerning avian prey alone, we can make the following distinctions, in regard to four phases of habitat:

	Species	Specimens
Aerial	23	87
Tree-tops	19	37
Open country	10	17
Jungle	4	5

A moment's consideration shows the reasonableness of the respective divisions and their relative numbers. We are dealing with predators whose method of hunting is by keenness of vision, with stance on a lofty, exposed perch, and an ultimate dive from a still greater height, plummeting at full speed upon the victim.

This explains the relative proportions of these subdivisions, the preponderance of aerial and tree-top species and numbers, the fewer number of open country, savanna and grass-inhabiting forms, and the disproportionately small percentage of prey living in the heart of dense jungle.